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A meta-theory analysis of teachers' beliefs and practice
with regard to low prior attaining students in mathematics:
The representations of teacher voice.

by

Rachel Helme

A dissertation submitted to the University of Bristol in accordance
with the requirements of the Degree of Master of Education in the
Graduate School of Education.

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SYNOPSIS

This study investigated the representations of teacher voice in literature that focuses on the teaching and learning of low prior attaining students. It considers two research questions: firstly, how is the complex relationship between a teacher's beliefs and observable practice represented in literature and to what extent is the subjectivity of interpretation acknowledged? and secondly, what could be the impact of giving priority to teacher voice in academic and other professional literature?

This is a mainly library-based study that uses the tenets of meta-theory to review the evidence in both academic and professional literature of the underlying assumptions of the researchers and authors. A sample of five current (2014 to present) research publications, as well as a sample of four publications that practitioners recommended as useful in the teaching of learning of low prior attaining students were reviewed and the findings compared. Although these are small samples, they afford the opportunity to open the discussion on the representation of teacher voice as well as consider the purpose of educational research.

After comparing the two different samples the results show that the literature chosen by practitioners seemed to put the voice of the teacher as central in the interpretation of the teacher's beliefs and practice and furthermore, focused on proposing and critiquing practical strategies that the teacher could introduce in the classroom. This was not always evident in the sampled current literature where the beliefs and practice of the teacher was often interpreted through the subjective lens of the researcher.

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I would like to acknowledge the effort of the authors of the literature that I reviewed in this study and the valued insight that their work brings to Mathematics and wider Education.

Finally, I would finally like to thank my husband Marc and children Rebecca and Joshua for their tolerance and reassurance over this past year. I would not have been able to be as successful as I have been without their love and support.

DECLARATION

I declare that the work in this dissertation was carried out in accordance with the regulations of the University of Bristol. The work is original except where indicated by special reference in the text, and no part of the dissertation has been submitted for any other degree.

Any views expressed in the dissertation are those of the author and in no way represent those of the University of Bristol.

The dissertation has not been presented to any other University for examination either in the United Kingdom or overseas.

Signed: _____

Date: _____

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CHAPTER 1 – RATIONALE

1.1 Introduction

It is widely acknowledged that the rate of progress of the lowest attaining students over the course of their formal mathematics education is not as strong when compared to that of their higher attaining peers (Boaler, Wiliam, & Brown, 2000). Commentators argue that the role of the teacher is pivotal in influencing the experiences and outcomes of students, and differing teacher expectations and restricted pedagogy, often a result of the concept of inherent ‘ability’, are said to inhibit opportunities for low attaining students to develop as independent learners (Mazenod, et al., 2018; Bohlmann & Weinstein, 2013). Furthermore, the low attaining students’ own narrative, when discussing their teaching and learning experiences in mathematics, alludes to feelings of frustration and marginalisation that is said to result from the aforementioned restricted pedagogy (Boaler, Wiliam, & Brown, 2000). It could be suggested that students are both aware they are getting a deficient experience when compared to their higher attaining peers, and that their frustrations are not given proper audience in their classroom and wider educational context.

1.2 Beliefs-practice relationship

The pedagogical choices of a teacher in the teaching and learning of mathematics are said to emerge from their underlying beliefs (Speer, 2005; Handal, 2003). As will be discussed in the next chapter, a teacher’s beliefs can be variously described as beliefs about the nature and teaching of mathematics as a school subject, as well as beliefs about the future mathematical potential of students, the teachers own role in the

classroom and influence in the wider educational discourse. It could be argued that teacher's beliefs, said to be influential in the choice of pedagogy, are the key determinant that impacts the classroom experiences of low attaining students. However, in the same manner that it is right to not consider the 'ability' of a student as an inherent characteristic, the next chapter will argue that it seems correct to also consider the beliefs, perceptions and practices of a teacher as a dynamic entity. Handal (2003) states that there is an interplay between beliefs and instructional practice in the classroom, although the author reminds us that it is often complex and influenced by other factors outside of the teachers control. Handel and Herrington (2003) suggest that attention should be given to addressing any possible misconceptions in the beliefs of teachers, and that this should be seen as the key factor in the success of any educational reform. Furthermore, Biesta, Priestley, & Robinson (2015) suggest that there is an interaction between beliefs and agency, that is having the capacity to shape and influence, that enables the teacher to be "explicitly positioned as agents for change" (p.625). It could be argued that attending to a teacher's belief-constructed practice could be seen as the foundations for change in the experiences of the lowest attaining students.

1.3 Teacher voice

As will be seen, review of academic literature suggests that although the role of the teacher is often viewed from a critical stance the voice of the practitioner themselves is often silent. The studies that purport to use teacher voice seem to have only given superficial attention to the 'what' of the actual words rather than to the 'why' behind the statement made. On the occasions where the teachers' beliefs behind a statement are considered, the beliefs interpretation is often constructed using the

voice of the academic researcher rather than that of the teacher participant; Herbst (1999) cautions that researcher-led interpretation should be seen as problematic due to the issues around subjectivity and the effect of the researcher themselves.

1.4 Overview of study

This study examines the narrative around teachers' beliefs and observable practice in literature that discusses the teaching and learning of lower attaining students in mathematics. It draws on debates around representation of the beliefs and practice of the teacher as well as the issues of subjectivity found in the interpretation process itself. It explores how a sample of current literature represents and interprets the relationship between a teacher's beliefs and observable practice, and to what extent the literature acknowledges the impact of socio-cultural context and discourse on teaching and learning. The study goes on to consider the impact of researcher-led and teacher-led interpretation of the beliefs-practice relationship, and to argue for the importance of having teacher voice in literature that describes and critiques their practice.

The reviewed literature is obtained from two contrasting sources and hence discussed in two parts. In the first part of the review, a sample of current academic literature (2014 to present) on the teaching and learning of low attaining students in mathematics is examined and evidence that suggests the underlying assumptions of the researchers is discussed. The impact of researcher-led interpretation is contrasted with the idea of a teacher-led triad of interpretation in order to ensure shared understanding in the process. In the second part of the review, literature that has been recommended by teachers and educational practitioners, stated as useful

in their classroom practice with low attaining students, is examined in the same manner as above and the increased utility when introducing the teacher's own voice and self-perceptions into academic and professional literature is discussed.

Interwoven into this study is my evolution within the dual role of an experienced teacher and a beginning academic researcher. As I strive to understand within my positioning within the teacher-researcher continuum, I construct my own thoughts on purpose of research-generated educational knowledge and its utility to the teaching community which will ultimately affect my future academic study.

In the next chapter, I explore the theory behind that underpins debate around the influence of beliefs on teachers' practice. I consider the meaning of the term 'beliefs' in relation to teachers and the issues around using the lens of observable practice as evidence of underlying beliefs.

Notes from the diary

Who am I?

After ten years as a secondary mathematics teacher and one year as a (very!) earlier researcher I have found that I am conflicted. Am a teacher or a researcher? Which side should I choose? If I chose one am I rejecting the other?

Why this study?

I wonder to what extent academic research is actually the voice of the teacher if meaning making also involves the socialisation of the researcher. Is the purpose and outcomes of educational research 'for' the teacher (collaboration) or 'of' the teacher (authoritarian)? Where is the teacher's voice interpretation of their pedagogical decisions?

In a world where the over scrutiny (read this as over criticism) of a teacher's practice is common place is research just another voice in this melee?

I have many questions.....



CHAPTER 2 – THEORETICAL DISCUSSION

2.1 Deficient pedagogy

The instructional practices of a teacher in the mathematics classroom are a key factor in influencing a student's level of affect towards the subject (McLeod, 1992) and development of self-concept as a mathematician (Upadaya & Eccles, 2015); this is said to be particularly evident in the educational encounters of the lowest attaining students (Boaler, Wiliam, & Brown, 2000; Watson & De Geest, Principled teaching for deep progress: Improving mathematical learning beyond methods and materials., 2005). Studies suggest that the student allocated the label 'low attaining' will experience a deficient mathematics curriculum as a response to the teacher's (mis)perception of prior attainment equating to ability, that is previous assessment results being interpreted as a measure of fixed future potential (Bohlmann & Weinstein, 2013; Watson, 2002). The resulting implemented curriculum is said to be deficient in both expectations of the student's classroom behaviour and mathematical capability, and the opportunity to learn content and develop transferable skills (Hallam & Ireson, 2005; Francis, et al., 2017). Furthermore, as a consequence of this restricted pedagogy the 'low attaining' student may experience disaffection (Boaler et al, 2000), promoted dependency (Mazenod, et al., 2018) and a widening of the achievement gap when compared to their higher attaining peers (Ireson, Hallam, & Hurley, 2005). Watson & De Geest (2005) state that the beliefs of a teacher are an important predictor for converting failure to success for the student with low prior attainment, and Handel & Herrington (2003) state that when wider educational or institutional reform is introduced to the classroom it has the most chance of success when a teacher's belief system is taken into account. Furthermore,

Stipek, Givvin, Salmon, & MacGyvers (2001) describe beliefs as “filters through which new information is processed” (p.224) and that understanding teachers’ beliefs may be key to changing classroom practice. In the next section, I discuss the various meanings attributed to the term ‘teachers’ beliefs’ and consider whether domain-specific beliefs or the wider macro-belief system are more influential.

2.2 Teachers’ beliefs

Cross (2015) defines a person’s beliefs as the:

embodied conscious and unconscious ideas and thoughts about oneself, the world, and one’s position in it developed through membership in various social groups, which are considered by the individual to be true. (p.175)

For the teacher, beliefs are considered as factors that are said to shape the daily decisions made by the teaching professional (Speer, 2005) and are diversely discussed in educational literature as beliefs about teaching and learning (Stipek et al, 2001), attitudes and perceptions drawn from past experience (Hallam & Ireson, 2005) and personal theories about the nature of knowing and knowledge (Handel & Herrington, 2003). For the mathematics teacher, beliefs are said to be divided into three distinct but interconnected domain specific categories, namely beliefs about the nature of mathematics, beliefs relating to the teaching of mathematics and beliefs about how students learn mathematics. (Cross, 2015; Beswick, 2012; Handal, 2003). A teacher is said to be one of the following belief-types:

- Instrumentalist: Mathematics is the accumulation of unconnected facts and processes to be memorised, teaching is content and performance focused, and learning is the passive reception of knowledge.

- Platonist: Mathematics is a static body of pre-existing and connected knowledge to be discovered, teaching is content and understanding focused, and learning is by active construction.
- Problem solving: Mathematics is a dynamic and creative process, teaching is learner focussed, and learning is by autonomous exploration.

(adapted from Beswick, 2012)

However, it could be argued that the aforementioned beliefs relate to the general pedagogy of mathematics but cannot account for the disparity of attainment-based practice of any one teacher. It could be argued that a broader set of macro-beliefs must be present and developed by a teacher through socialisation in the educational context, that is considered to be of significant influence on the actualisation of their beliefs (Cross, 2015). It is argued that the profession appears to forge the beliefs as opposed to the beliefs moulding the teacher (Handal, 2003; Beswick, 2012). The macro-beliefs of a teacher are described by Biesta, Priestley, & Robinson (2015) under three headings, namely beliefs relating to students, beliefs about their role as a teacher and beliefs about the purpose of education.

2.2.1 Macro-beliefs relating to students

Power (2012) argues that professional and institutional discourse is a key factor in influencing the beliefs of teachers regarding students and is often enmeshed in a 'sufficient' versus 'deficit' viewpoint, that is to say the 'bright' student that needs to be stretched and challenged, and the 'less able' having an educational defect that needs to be 'fixed'. This professional discourse is said to often override the teacher's awareness of individual capabilities, and thereby the allocation of attainment labels

leads to groups of students, with different mathematical characteristics, being viewed as homogeneous in their needs (Boaler, Wiliam, & Brown, 2000). The commentators go on to suggest that this standardisation of students within a teaching group can result in a pedagogical practice that is not able to meet the needs of all learners in the classroom. For the low attaining student, the impact of teachers' macro-beliefs relating to students is considered to be of most significance in their potential classroom experience and consequently their future attainment (Boaler, Wiliam, & Brown, 2000; Francis, et al., 2017). It is claimed that the teacher's own perception of ability contributes significantly to a student's own self-concept in mathematics, and when balanced with timely feedback on effort and hard work, the teacher can have the opportunity to positively influence the confidence and motivation of students (Upadaya & Eccles, 2015; Stipek et al, 2001).

2.2.2 Macro-beliefs about their role as a teacher

Recent research states that the teacher's perception of their role in the classroom has altered from that of a deliverer of knowledge to that of a facilitator of learning (Biesta, Priestley, & Robinson, 2015). Yandell (2017) argues that the conceptualisation of knowledge as the possession of the teacher, to be 'delivered' to students is misleading in the disregard of the social nature of knowledge work. For the mathematics teacher, the perception of role is said to be influenced by the perception of how students learn mathematics, passively received knowledge in contrast to constructed understanding (Stipek et al, 2001). Furthermore, the perceived role of the teacher can be influenced by the opinion of mathematics as the school subject, as opposed to that of mathematics as a discipline (Beswick, 2012),

that is to say a disconnect between how mathematics should be introduced in school compared with the mathematician's own experience of the discipline. From the position of the student, the role of the teacher is similarly constructed by a perception of mathematics as a 'hard' discipline where a more teacher-led approach is more than likely expected in the classroom than in called 'soft' subjects where a more student-led approach may be conventionally experienced (Beusaert & Segers, 2013). Conversely, within the low prior attaining classroom, the narrative around the role of the teacher suggests that there is a need to focus on student behaviour management as opposed to learning facilitation, with issues around keeping students on task and dealing with poor conduct, as well as the need to provide more structured work to account for the perceived students' lack of independence with learning (Mazenod, et al., 2018). It could be argued that the role of teacher, in the teaching and learning of low attaining students, is viewed as more of a 'gate keeper' than a learning facilitator.

2.2.3 Macro-beliefs about the purpose of education

The purpose of education, in this case formal schooling, is seen as a fundamental part of preparing students to thrive in the modern world, creating empowered, fulfilled individuals and as a consequence, peaceful and sustainable societies (Fadel, Bialik, & Trilling, 2015) . However, Biesta et al (2015) state that much of the professional dialogue around the purpose of education is relatively short-term in nature, focusing more on the day to day methods of teaching and learning than the longer-term aim of the holistic acquisition of mathematics knowledge. Furthermore, they suggest that this disconnect between methods and purpose can lead to a reduction in teacher agency and consequently an impact on the quality of education that results. It could

be argued that the socio-cultural setting of a teacher's workplace, driven by annual appraisal targets, creates a contextually focused short-term goal mentality that could lead to classroom practices in conflict with the teacher's macro beliefs regarding the purpose of mathematics education (Kerem Karaagac & Threlfall, 2004).

The nature of a teacher's professed macro beliefs is complex and are viewed by some as entities that are situated in, and therefore moulded by, the socio-cultural context (Speer, 2005; Hallam & Ireson, 2005; Cross, 2015). Furthermore, beliefs are said to be influenced by teacher related factors constructed by prior experiences in the profession (Beswick, 2012), suggesting that the connection between beliefs and classroom pedagogy is synergistic rather than linear in relationship (Cross, 2015). In the next section, I consider the influence of beliefs on classroom practice and whether observable practice can be seen as evidence of underlying beliefs. I discuss whether contradictions can arise between a teachers' professed beliefs and those that are inferred from their practice.

2.3 The relationship between professed beliefs and observable practice

The influence of beliefs on a teacher's choice of instruction practice has been widely studied and is considered by some commentators to be irrefutable (Stipek, Givvin, Salmon, & MacGyvers, 2001; Beswick, 2012; Beausaert & Segers, 2013), although it is acknowledged that this relationship is often mediated by contextual pressures and other teacher related factors (Handal, 2003; Cross, 2015). The observable practices of teachers with regard to low attaining students are often ascribed as overt evidence of their macro-beliefs, but this assumption is potentially problematic. Cross (2015) states that a teacher's macro-beliefs cannot be observed but only inferred from the classroom practice, and Handal (2003) remarks that institutional obstacles may

create barriers that prevent teachers from fully implementing belief-led practice in the classroom. Furthermore, Richardson (in Handal, 2003) states that changes in beliefs do not necessarily lead to changes in practice, particularly when a teacher is unsure how to actualize the practice that may be associated with this change in belief. It could be argued that it is possible for the deficit pedagogy attributed to the teaching and learning of low attaining students to be in conflict with a teacher's professed mathematical and macro-beliefs, juxtaposing with the interpretation of academic literature. However, for Philipp (2007, in Cross, 2015) the view of a conflict between professed beliefs and observable practice is also problematic, suggesting that many of the reported contradictions exist in the mind of the researcher and not within the teacher, that is to say the apparent conflict identified can arise from lack of shared meaning of vocabulary between the teacher and the researcher (Beswick, 2012). For Speer (2005), the distinction between professed and inferred beliefs are a false dichotomy, the cause of which she ascribes to the methods and theories that the researcher brings to a project. The data collection and analysis that claims to have isolated the teacher's beliefs ignores the impact of the research context, the so-called researcher effect (Wellington, 2015), and the influence of the researcher's own interpretative stance (Speer, 2005; Kerem Karaagac & Threlfall, 2004). Furthermore, the meanings, or categorisations, given to professed or inferred beliefs of a teacher are applied through the interpretative lens of the researcher (Morgan & Xu, 2011). Speer (2005) goes on to suggest that professed beliefs and observable practice should not be viewed as separate but synergistic, and reflection should move away from researcher-led to participant-led interpretation, in order to create shared understanding.

The issues around the purported voice of the teacher as represented in research are complex, as the inferred beliefs of teachers through their observable practice may not be a genuine representation of their macro-beliefs. Leat, Reid, & Lofthouse (2015) state that the voice of the teacher is often represented through the subjective lens of academic authors rather than a “generation of meaning” (Wertsch, 1991, p.74) by all involved. Speer (2005) states that beliefs are not the sole determinant in the teacher’s choice of instructional practice and therefore it could be argued that it is not possible to attribute the macro-beliefs of a teacher based on observation of practice alone. The influence of the social context and discourses that surround the practitioner may be significant enough to impact the teacher’s classroom practice, notwithstanding the tension with their macro-beliefs.

Below, I review a sample of current literature that discusses both the professed beliefs and the observable practice of the teacher with regard to low attaining students. Firstly, I describe the methodology and the tenets of meta-theory as they are applied to this process. Then I discuss how the relationship between beliefs and practice is represented, and how the possible tension influenced by social context and discourse is acknowledged. Finally, I consider how the studies confront the subjectivity of the academic researcher who authored the studies. (see Figure 1 for the beliefs-practice-subjectivity domains used in the analysis process).

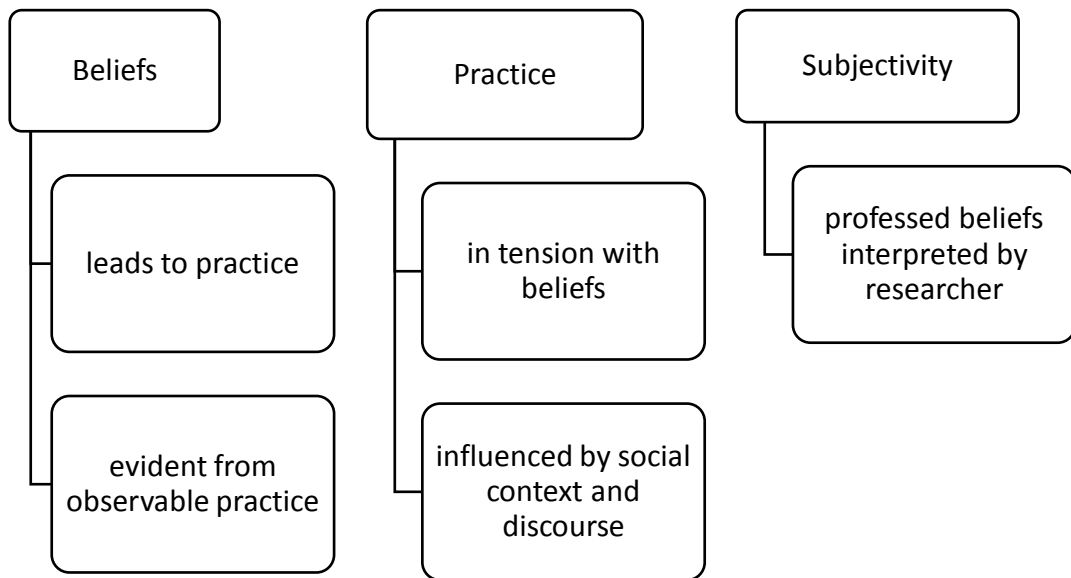


Figure 1: Domains for analysis, beliefs-practice-subjectivity framework

Notes from the diary

CAUTION! => no categorisation is independent of the researcher.

There is potential for my own investment in this topic to bias my sampling and interpretation, do not search for my perception of 'deficiency' in research but recognise the actual evidence in the literature, being fair and reasonable to the authors.

(An interesting shift in thinking here!)

CHAPTER 3 - METHODOLOGY

3.1 Introduction

The purpose of this research project is to highlight the extent to which teacher's voice is present in the characterisation of teacher's beliefs in literature regarding low prior attaining students in mathematics; more specifically it will consider how the primary literature develops and interprets the possible synergistic relationship between teacher's beliefs and their observable actions in the classroom in the theoretical framework. The research design could be described as 'naturalistic' in nature as much of the details of the methodology emerge as the study progresses (Wellington, 2015). The tenets of a meta-analytical approach are applied to the qualitative data to highlight the influences that theoretical assumptions may have on the methods and conclusions of the researcher (Timulak, 2009). Below I discuss the term meta-analysis and how it can be applied in the qualitative paradigm.

3.2 Meta-analysis

The term 'meta-analysis' was first coined by Glass (1976) to describe the statistical re-analysis and subsequent interpretation of a large collection of data aggregated from a number of connected studies and has been used to this purpose widely in the field of quantitative health research (Borenstein & Hedges, 2009). The benefits of meta-analysis in the quantitative field lie in the opportunity to use a larger set of data to bring more precision to the estimates of real parameters of the outcomes reported in the primary studies (Timulak, 2009). In a similar manner, the meta-analysis of qualitative studies is the process of a systematic review and a secondary interpretative analysis in order to provide a more comprehensive qualitative picture of various studies into the same phenomenon (Nye, Melendez-Torres, & Bonell,

2016; Timulak, 2009). Hoblit & Hare (1988) state that, in contrast to quantitative studies, qualitative meta-analysis does not necessarily take the approach of aggregation of data but could be viewed as synthesising the translations of the studies into one another in order to find either commonality, investigate refutability, or amalgamated to represent a new line of argument. Furthermore, they state that “the nature of the debate, not the synthesis itself, should be regarded as evidence of success” (p.35), that is to say it is the dialogue and discussion that arises as a response to the synthesis that is of significance over the synthesis itself. Timulak (2009) states that in addition to the aforementioned comprehensive picture, qualitative meta-analysis has a second primary goal, namely the assessment of the impact of theoretical and methodological orientations on the outcomes of the primary studies. Paterson, Thorne, Canam, & Jillings (2001) suggest that this part of qualitative meta-analysis, which they define as meta-study, includes meta-data-analysis, which is the discussion and interpretation of findings from the primary research, meta-method, a focus on the methodological quality of the primary research, and meta-theory, which explores the theoretical background and formation present in the primary studies. Below I discuss how this project is situated within the tenets of meta-theory and the key processes in this analytical approach.

3.3 Meta-theory

Zhao (1991) states that meta-theory consists of three main subbranches, firstly the examination of the underlying structure and assumptions of theory, secondly the prescriptive search for new theoretical direction, and finally the actual construction of a new overarching theory. This project aligns with the first subbranch, described by Paterson et al (2001) as the “critical exploration of the theoretical frameworks or

lenses” (p.91) in order to better understand both the theoretical landscape of the primary research, and the theory developed as a conclusion of the primary research. More specifically, this project will use the framework of meta-theory to discuss how the primary literature seems to develop and apply the theoretical framework with regard to the possible relationship between teacher beliefs and their observable actions in the classroom.

There are said to be two key stages in meta-theory that must take place before the final synthesis and theory analysis, namely the inclusion and appraisal of primary literature, and the extraction and analysis of the data of interest (Paterson et al, 2001).

3.3.1 Inclusion of primary literature

The decisions around the inclusion of primary literature can be challenging in both the retrieval and the appraisal process (Paterson et al 2001). Issues around the potential for researcher bias, due to my dual role of a teacher practitioner and an academic researcher, need to be mitigated (Kahn, Wareman, Young, Willis, & Pikington, 2008). In a larger scale project with a team of researchers, it is possible to encompass a wide range of information sources, including library books, and government reports as well as hand searching journals, however due to the limited resources of a single researcher the decision was made to restrict the primary literature search to peer reviewed, academic journals. Furthermore, whilst noting that a wider range of evidence may be available by supplementing the sampling process with other strategies, for example checking reference lists and searching conference abstracts (Stanfield, Brunton, & Rees, 2013), due to the limited resource

two sampling methods were chosen to select the primary studies, a systematic search, and recommendations from teacher practitioners, balancing the researcher sourced literature with the teacher practitioner perspectives of useful research (Kahn, Wareman, Young, Willis, & Pikington, 2008). The sample could not be described as either comprehensive or representative, the outcomes of which could be generalised, but a purposeful, convenience sample in order to open the conversation on how teachers' beliefs are represented in academic literature.

There is a consensus that the use of a range of systematic search methods is important to source the primary studies, including both topic-based database searches and internet search-engines (Stanfield, Brunton, & Rees, 2013). Campbell, Taylor, Bates, & O'Connor-Bones (2018) state that the internet search engine Google Scholar has appropriately high levels of sensitivity to search terms to validate its use alongside databases like BEI (British Educational Index) and ERIC (Educational Resource Information Centre) and therefore all three sources were used for the systematic search. The key search terms used were LOW* to cover the range of term like lower and lowest, ATTAIN* to cover the range of terms like attainment and attaining, both terms being applied together as the phrase LOW* ATTAIN*, and MATH* to cover the range of terms for mathematics. Due to the often (mis)application of prior attainment to innate ability, a second database search was completed substituting the term ABILIT* in the place of ATTAIN*. Finally, the filters of 'academic journals' and 'peer reviewed' were applied, and the date range was restricted from 2014 to the present to ensure only more current studies were in the sample. See Table 1 below for the number of results returned from the systematic search using these search terms.

Sample source	Number of results ATTAIN*	Number of results ABILIT*
ERIC	30	62
BEI	15	14
Google Scholar* (*Search terms adjusted, see below)	534	5640

Table 1: Number of results using search terms

Within Google Scholar it is not possible to apply the filters of ‘academic journals’ and ‘peer review’ and a pilot search was carried out. By restricting to articles dated 2014 to present, using the key terms previously discussed in the advance search and choosing the options ‘with **all** of the words’ and ‘anywhere in the article’ the pilot search returned a large number of results (ATTAIN* = 16700 results and ABILIT* = 17400 results). As it would be not possible for a single researcher to appraise such a large number of results, a second pilot search adjusted the advance search options to ‘with **all** of the words’ and ‘in the title of the article’, however the result was no responses (n=0) for either ATTAIN* or ABILIT* within the time frame applied. A further pilot search was carried out using the key terms and date filters as above but in addition the ‘with the **exact phrase**’ option of ‘low attaining’ and ‘low ability’ as applicable reducing the number of responses to a more manageable, but still numerically significant, amount as shown in Table 1. At this stage, due to the restricted resources of a single researcher the decision was made to confine the final sample size, initially using the ERIC and BEI databases and then Google Scholar until five different items of literature were sourced.

×
Advanced search
Q

Find articles

with **all** of the words

with the **exact phrase**

with **at least one** of the words

without the words

where my words occur

☒ anywhere in the article
 ☐ in the title of the article

Return articles **authored by**
e.g., "PJ Hayes" or McCarthy

Return articles **published in**
e.g., J Biol Chem or Nature

Return articles **dated between** —
e.g., 1996

Figure 2: Google Scholar Advance Search Options

The source of research literature obtained through recommendations from colleagues can be described as a convenience sample (Wellington, 2015), however is useful in mitigating the influence of my own investment in the topic of study (Timulak, 2009). Whilst acknowledging the definition of a sample frame (Wellington, 2015), my contacts within teacher discussion forums on twitter were used as the population for sampling purposes. This population could be considered as suitably diverse in nature including a range of practitioners within mathematics education as well as educational training providers and academic researchers. A message was posted on twitter briefly describing the project and asking for practitioner recommendations with a link to the online survey tool, thereby introducing anonymity into the recommendation process. This allowed for adequate information to be provided to enable informed consent, and respondent confidentiality as well as to alleviate any issues around perceived power relations between the respondent and the researcher (Matthews & Ross, 2010).

Paterson et al (2001) state that it is essential to develop a systematic approach to reviewing and appraising primary studies in order to ensure the principles of rigor are attended to, with Glass (1976) reminding us that "even 'poorly done' studies give important data" (p.4). Furthermore, the inclusion and more importantly exclusion of studies, based on a subjective perception of quality, can have a significant effect on the resulting conclusions (Timulak, 2009; Nye et al, 2016). For this study the appraisal process involved the sensitive reading of the abstract of the primary literature searching for statements that refer to the beliefs of teachers as well as reference to the terms in keywords list, with an axial coding approach used to identify other emerging related terms (Nye, Melendez-Torres, & Bonell, 2016). Further inclusion subcategories were considered for appraisal based on the desired phase of the teacher (secondary) and the educational system (UK), however due to the very low number of possible studies in the sampling response (n=1), this was revised to include studies using both primary and secondary phase teachers, with no restriction on the education system. There were no further restrictions applied based on other features, for example type of study, data collection processes or analysis orientation, however a step was introduced to the appraisal proforma (see appendix A and B) to ensure that each study was unique, avoiding any potential bias in results that could be caused by multiple literature from the same study. The final appraisal terms are shown in Table 2.

Teachers:	Appraisal terms including alternative terms with similar meanings
Professed or inferred Beliefs	Beliefs; Assumptions; Expectations
Classroom pedagogy	Pedagogy; Instruction; Practice
Discourse regarding ability	Discourse

Table 2: Appraisal Search Terms

3.3.2 Extracting the data

The answer to the important question of what constitutes the data for meta-analysis is led by the focus of the research question (Timulak, 2009) and within meta-theory the focus can involve the implications of the theoretical orientation of the primary studies (Paterson et al, 2001). For the purposes of this study, the “theory framed research” (Paterson et al, 2001, p.93) focuses on how the underlying assumptions of the researcher or author could be viewed as evident in the development and discussion of their findings around teacher beliefs and observable actions with regard to lower attaining students in mathematics; in particular the assumptions around the three concepts of macro-beliefs, namely beliefs relating to students, beliefs about their role as a teacher, and beliefs about the purpose of education. Initially, embedded in this process was a review of the type of literature that the authors of the primary studies cited to support their underlying assumptions, however during the extraction process it became apparent that the majority of the assumption laden discussions were presented without citing sources specific to the beliefs-practice-subjectivity domains (see Figure 1 for domains for analysis) and therefore the extracted data takes the form of sections of text from the literature without

reference to any citations, except in the case where it may be useful to understand the intention of the extracted text.

Timulak (2009) states that the “descriptive-interpretative approach” (p.595) to data analysis provides a conceptual framework useful for both phenomenological and interpretative studies. The steps in this approach are: domains development, delineating meaning units, and generating categories through comparison to enable abstraction of the main findings. Firstly, within domain development it is suggested that the domains can be a mixture of the pre-established deduced categories and emerging categories by a process of induction (Kahn et al, 2008; Wellington, 2015), thereby recognising the issues around criticality and openness to alternative interpretations. Within this first step of the approach, whilst acknowledging the aforementioned issues, it was decided for this study to constrain the domains to the deduced categories within the beliefs-practice-subjectivity framework (figure 1) used for the extraction process.

The second step is inspecting the narrative data in order to divide into distinct meaning units that enable both the comparison of data and identification of the origin (Timulak, 2009). A meaning unit or “interpretive metaphor” (Noblit & Hare, 1988, p.28) can be described as individual component that can convey meaning without the need for contextual information (Timulak, 2009; Noblit & Hare, 1988). The process of “careful and thoughtful reading” (Paterson et al, 2001, p.95) within meta-theory is considered a significant step in order to recognise both the overt and the covert ways in which the theory may have been influenced (Paterson et al, 2001). Finally, the meaning units are clustered together based on similarities and each

cluster is labelled to give a sense of the theme and commonality that the clustered meaning units contain (Timulak, 2009). The final clustered categories are shown below in Table 3 as well a description of the characteristics of each related meaning unit.

Domains (See Figure 1, chapter 2)	Clustered categories	Characteristics of meaning unit
Beliefs lead to practice	Beliefs lead to deficient practice	Beliefs stated as a precursor to deficient practice: The teacher's belief is [...] which results in deficient practice in the classroom or deficient practice is a result of the teacher's beliefs about [...]
	Beliefs lead to sufficient practice	Beliefs stated as a precursor to sufficient practice: The teacher's belief is [...] which results in sufficient practice in the classroom or sufficient practice is a result of the teacher's beliefs about [...]
	Teacher's beliefs significant for low attaining students	Teacher's beliefs are stated as an important factor that can influence the success of low attaining students.
Beliefs evident from practice	Deficient practice stated as evidence of deficient beliefs	The teacher's practice is present as overt evidence of beliefs: The teacher's beliefs about [...] were inferred because they did [...] in the classroom or the teacher's practice suggests they believe [...]
	Students awareness of beliefs from practice	The teacher's beliefs are inferred by the student by their observable practice: The practice of the teacher demonstrates to the students that the teacher believes [...] and encourages the student to believe [...]
Practice in tension with beliefs	Teachers are aware but do not challenge practice tension with macro-beliefs	The teacher states that [...] practice is not compatible with their beliefs about [...] but felt they had no option but to comply because of [...].
	Teachers challenging practice in tension with macro-beliefs	The teacher states that [...] practice is not compatible with their beliefs about [...] and therefore they do not comply. Or teachers demonstrate alternative practice to 'norm' due to beliefs about [...]

Practice influenced by socio-cultural context	Acknowledging the importance of context	Observable practice is a result of institution pressures or wider educational policy (it may be stated that this overwhelms macro-beliefs).
	Negative influence of context	The context is presented as having a detriment effect on practice or deficient practice is mitigated by reference to contextual pressures.
	Positive influence of context	The context is presented as having a positive effect on practice or sufficient practice is linked to contextual support or freedom.
Subjectivity Professed beliefs interpreted by researcher or author	Researcher or author interpretation used	The researchers or authors use their own interpretation of a teacher's beliefs from observable practice: The teacher's action of [...] suggest that they believe [...] or We (the authors) conjecture that the teacher believes [...]
	Acknowledging subjectivity in interpretation	The researchers or authors explicitly state the issues around interpretative subjectivity: I may have observed [...] but subsequently misunderstood the reasons for this action or this interpretation is my perception of what was observed.
	Agency and voice with the teacher	Teachers are presented as a key factor in the success of sufficient practice: Teachers can make insightful decision about [...] or when teachers are given freedom to innovate about [...] or we (the researchers) did not tell the teachers what to do, they made their own decisions...

Table 3: Clustered categories and characteristics of meaning units

3.4 Synthesising the data

Timulak (2009) states that within meta-analysis, the synthesis process is the focused and conclusive theoretical interpretation of the main findings in order to present a clear proposition for theory, practice and future research. Furthermore, Noblit & Hare (1988) suggest that an interpretation "enables the reader to translate the case into [their] own social understanding"(p.18) and as a consequence provides a viewpoint that may enrich discourse. Within meta-theory specifically, the process involves the

analysis of factors that may influence the conclusions rather than the collective weight of the conclusions themselves (Paterson, Thorne, Canam, & Jillings, 2001). Within this study, the data extracted is synthesised in a two-stage process. In the first stage, the clustered data is considered separately within the two 'source-types' of sampled literature and literature recommended by practitioners, to build an overall picture of how each source-type represents the voice of the teacher. Applying the method of constant comparison and contrast (Wellington, 2015), the beliefs-practice-subjectivity framework (figure 1) was used to consider and discuss the extent to which the data could imply the underlying assumptions of the authors and researchers within each source-type. This first stage process attends to the first research question, namely how is the complex relationship between a teacher's beliefs and observable practice represented in literature and to what extent is the subjectivity of interpretation acknowledged?

Noblit & Hare (1988) describe synthesis as "making a whole into something more than the parts alone imply" (p.28) and Tesch (1990, in Wellington, 2015) states that "the final goal is the emergence of a larger, consolidated picture"(p.278). Within the second stage the individual findings from each source-types were juxtaposed and the method of constant comparison and contrast (Wellington, 2015) was applied to consider and the similarities and differences between the results within the beliefs-practice-subjectivity framework. Noting the comments of Timulak (2009) about the practical utility of meta-analysis, the second stage synthesis goes on to discuss the implications of these findings in relation to the second research question, namely what could be the impact of giving priority to teacher voice in academic and other professional literature?

In the next chapter, I use the beliefs-practice-subjectivity framework to discuss the results from the sampled research publications.

Notes from the diary

There is a certain irony in an essay that critiques the assumption that a teacher's beliefs can be observed from practice and yet the essay itself is inferring the researcher's beliefs from their practice, that is the findings in the literature!

I must acknowledge my own subjectivity and consider how to put to aside my own opinions that may lead me to only see what I want to see.

Being a researcher is challenging

CHAPTER 4 – RESULTS FROM SAMPLED RESEARCH PUBLICATIONS

4.1 Introduction

The results of this section of the study are drawn from the review of a sample of academic literature that discusses the macro-beliefs and classroom practice of teachers in relation to low prior attaining students. The data extracted as text from the primary research is clustered to give an overall picture of how the authors represent teachers' voice , and to consider any evidence of underlying assumptions within the domains of beliefs and practice as well as an awareness of the subjectivity of the researchers.

4.2 Introducing the primary literature sample

The systematic database search and appraisal process resulted in a final sample of five research publications that discuss issues around the teaching and learning of low prior attaining students. (see appendix A). Three of these publications report on specific issues within the findings of larger studies, and two discuss stand-alone projects, one of which was initiated by a group of three mathematics departments in schools. Four of the projects are based on the teaching and learning of primary school students (aged 4 to 11 years old), of which two are within the UK education system, one is within the Dutch education system and one is within the New Zealand education system; the final project focuses on the teaching and learning of secondary school students (aged 11 to 16) within the UK education system. Table 4 shows a summary of the study type in intersection with nationality and age range.

	UK Age 11-16	UK Age 4-11	Dutch Age 4-11	New Zealand Age 4-11
Larger project		2		1
Stand-alone project	1		1	

Table 4: Intersection of study type with nationality/age range.

4.2 The language of beliefs

Cross (2015) defines a person's beliefs as the:

embodied conscious and unconscious ideas and thoughts about oneself, the world, and one's position in it developed through membership in various social groups, which are considered by the individual to be true. (p.175)

In the sampled academic literature, the use of the term 'beliefs' or derivatives thereof was not numerically significant, occurring on only five occasions in the seventy-three items of extracted text. However, as Pajares (1992) states, the meaning of the term 'beliefs' frequently "travel(s) in disguise and often under alias" (p.309) and accordingly, the authors used a variety of other terms that for the purposes of this study I align with the "embodied conscious and unconscious ideas and thoughts" (Cross, 2015, p.175) in the aforementioned definition. See Table 5 for terms used and the dictionary sourced definitions; where applicable further information is given from the source literature to illustrate the impact and meaning for the author.

Term	Definition
Position	A particular way in which someone is placed; The authors state that "Once positioned...a person sees the world from the vantage point of that position" (Tait-McCutcheon & Loveridge, 2016, p.329)
Perceive	To interpret, regard or understand something in a particular way
Regard	To consider or think in a specific way

Aware	To have knowledge or perception of a situation or fact
Grounded (in)	To give a firm theoretical or practical basis
Theory	A supposition or system of ideas intended to explain something
Assume	Suppose to be the case (without proof)
(Shared) understanding	A (shared) perception or judgement of a situation
Storyline	In this context defined by the authors as “developing in a social episode, how people present themselves ... and evidence of their position”. (Tait-McCutcheon & Loveridge, 2016)
Expectation	A belief that someone will or should achieve something (Low expectations: will not or should not achieve something)
View	To regard something in a particular light or with a particular attitude

Table 5: Definitions sourced from English Oxford Living Dictionaries (2017)

4.4 Underlying theoretical assumptions

The English Oxford Living Dictionary defines of an assumption is “a thing that is accepted as true or as certain to happen, without proof” (English Oxford Living Dictionaries, 2017). The theoretical assumptions held by a researcher, be they overt or covert, have the potential to impact on the outcomes of their study (Wellington, 2015). The discussion that follows does not consider whether the assumptions are appropriate in these cases, nor the contentious issue of ‘without proof’ that the word implies, however the review does identify text from the literature that could lead the reader to infer the theoretical underpinning of the study and the researchers involved. Below, I discuss evidence from the literature of the assumptions around the relationship between beliefs and practice, and the acknowledgement of the impact of context on teacher’s practice.

4.4.1 Beliefs and practice

The underlying assumption regarding the relationship between professed beliefs and observable practice can be considered from two different, but connected, viewpoints. Firstly, the assumption that the professed beliefs of a teacher will inevitably lead to a particular type of practice in the classroom and secondly, the assumption that the observable practice in the classroom can be considered as direct evidence of a teacher's belief system.

The first assumption presupposes that there is a linear relationship between professed beliefs and observable practice that can be known by noting the expressed beliefs of the teacher. The assumption that the beliefs of the teacher regarding low attaining students will lead to a deficient pedagogy seems evident from statements such as:

They expressed lower expectations of [the student's] capabilities....The teachers perceived her as demanding in both expertise and time...and she was set less challenging work (Alderton & Gifford, 2018, p.62)

Shared assumptions about set 4 pupils' behaviour also restricted the pedagogical approaches taken....[the teacher] made a conscious effort to restrict [discussion and collaborative work] on the basis of beliefs that set 4 were unable to engage... (Marks, 2014, p.49)

This narrative data seems to state that the teaching and learning decisions made for the low attaining students in these classrooms were as a direct response to the low expectations and assumptions, namely the beliefs, of the teachers involved. It is difficult to distinguish whether these comments are the direct voice of the teachers involved or an interpretation of interview data by the researcher, and the extent to which the researchers unpacked the 'expectations' and 'assumptions' of these teachers is unknown. It could be argued that these statements infer that the

assumption of a simple, linear beliefs-to-practice relationship is considered present in these cases.

However, the belief-to-practice relationship is not necessarily viewed as inevitable, as seen in these examples:

The teacher might lower their expectations for these [low ability] students and more time may be spent on behaviour management (Faber, Glas, & Visscher, 2018, p.47)

... assumptions about these pupils, based on beliefs about ability, may be leading to missed opportunities [for discussion]. (Marks, 2014, p.50)

(My emphases)

The use of the words 'might' and 'may' suggests that the authors are tentative in suggesting that beliefs lead directly to observable practice, although it seems that there is an awareness that it is a possibility.

For one study, as a result of the participation and observation of teachers in the project, the authors conclude that teacher's beliefs about the nature of teaching and learning of mathematics lead to the observable practice with the lowest attaining students, stating for example:

We identified emerging storyline from the teacher positioning....For example, an emerging storyline from [the teacher's] positioning is that mathematics is a collaborative endeavour. (Tait-McCutcheon & Loveridge, 2016, p.335)

The teacher is positioned, and therefore is considered to view, or have the belief, that the teaching and learning of mathematics is a collaborative endeavour, furthermore the authors go on to claim that, because of her positioning, this teacher sought to "create a feeling of collaboration and shared responsibility" (p.344) in the classroom.

Conversely, Watson & De Geest (2014) whilst acknowledging that “the centrality of high expectations of learning emerges as a critical factor in many studies”(p.354) into the effect of professional development around the teaching and learning of low attaining students, go on to say:

...but for improving learning there are the additional conditions of collaborative transformation of the curriculum into schemes of work. Talking about subject content and teaching in a critical manner, including handling differences, might make important contributions to change. (p.355).

It is interesting to note the inference that collaborating on both mathematical and pedagogical knowledge, as opposed to explicitly attempting to address the teacher’s macro-beliefs, is important to changing the teaching and learning experiences of the low prior attaining student. It could be argued that the possible changes in teachers’ beliefs are implicit in this process.

The second assumption presupposes that there is a linear relationship between professed beliefs and observable practice that can be known by noting the observable practices of the teacher. The assumption is that the practice observed with low attaining students is direct evidence of the underlying macro-beliefs of a teacher. For example, having observed the practice of two teachers, it was concluded that :

[The first teacher] positioned the students as having the duty to individually and collaboratively participate...when she asked the student to individually show me, explain the answer...collaboratively when she referred to everyone using first person plural pronouns...[and] to check each their answers, understand and provide clear explanations. (Tait-McCutcheon & Loveridge, 2016, p.339)

[The second teacher] positioned the students as having an individual duty to participate in the mathematics teaching and learning by listening, looking and writing...[by] using first person singular pronouns.... Students were mutually positioned as having the duty to follow her instructions. (Tait-McCutcheon & Loveridge, 2016, p.341).

The researchers seem to interpret the observable practice of these teachers as correlating to their positioning, or beliefs, about the teaching and learning of mathematics. It could be said that they ‘observed’ the beliefs through the filter of the overt classroom practice. However, although the practice-to-beliefs relationship is implied six times in the study referenced above, the data extracted from all five sources when considered as a whole seems to suggest that there is less consensus of this assumption. Isolated statements were present, such as:

[The teacher] decision to give [the student] work at a lower level than the test suggests that she regards her as a hopeless case. (Alderton & Gifford, 2018,p.62).

The belief that any dispute occurring with low ability labelled pupils must be non-mathematical may have led to [the teacher] missing an opportunity to engage the pupils in this mathematical concept. (Marks, 2014,p.49)

The use of the words ‘suggest’ and ‘may’ (my emphases) could infer that the researcher’s interpretation is that there is a possible, but not conclusive, manifestation of beliefs in this observable practice. Interestingly, the studies by Faber, Glas, & Visscher (2018) and Watson & De Geest (2014) make no reference to the practice-to-beliefs assumption when in discussion about the teaching and learning of the low attaining students which could suggest that this assumption is not present within these studies.

4.4.2 Practice and contextual pressure

The underlying assumption regarding the possible effect of contextual pressures on practice can be considered from two viewpoints that could challenge the beliefs-to-practice-to-beliefs thinking. Firstly, the assumption that the observable practice of a teacher can be in tension with their macro-beliefs and secondly, the assumption that observable practice can be influenced by social context or discourse.

The first assumption suggests that the observable practice in the classroom cannot necessarily be considered as evidence of a teacher's macro-beliefs as it is possible for the teaching and learning in the classroom to be in tension with the teacher's beliefs, and importantly, that the teacher is aware of this contradiction. The converse instance where a teacher may not recognise the practice-beliefs tension will be further discussed later in this section.

This tension-awareness is acknowledged by of the two studies:

[The teacher] notes that, although he sees the system as ludicrous, it exerts a powerful influence. Schools ... appear to be in a position where they have little choice but to play the accountability game. (Marks, 2014, p.50)

The teachers, particularly [named teacher], appeared to be aware of being caught between contradictory discourses, operating between the demands of accountability and inclusivity. (Alderton & Gifford, 2018, p.64)

These teachers, certainly in the interpretation of the researcher, are aware that elements of their practice are not compatible with their beliefs but "saw no other option without jeopardising the school rank and implicitly their own career" (Alderton & Gifford, 2018, p.62). Evidence of this assumption is not explicitly mentioned in the three remaining studies, although Watson & De Geest (2014) do refer to the work of Venkatakrisnan (2004, in Watson & De Geest (2014)) in which a comparison is made regarding the response to government guidance and that for one department:

It was impossible to apply the [government] guidance [on teaching and learning] without disrupting their equitable, independent, exploratory approach to mathematics. The 'guidance' and the externally imposed implementation methods were potentially destructive. (Watson & De Geest, 2014, p.355).

It could be argued that the author suggests the members of the mathematics department were aware of, but in contrast to the previous point would not accept,

the tension between their beliefs about the teaching and learning of mathematics and the so called imposed guidance, however this could also be viewed as the interpretation of the researcher, or in this case the interpretation of a secondary researcher on primary research findings, rather than the teachers own voice on the matter.

The second assumption suggests that the issues of observable practice as evidence of macro-beliefs is problematic due to the influence of the professional socio-cultural context of the teacher and the discourses of their institution. This assumption has similarities to the aforementioned in that practice may be in tension with beliefs, however it does not comment on whether the teacher is explicitly aware of these tensions, that is to suggest that the influence is significant enough to overshadow the teacher's beliefs. It could be argued that wider institutional and educational practice that may have been in tension with their macro-belief system has become engrained in the culture so as to create a new, if temporary, belief system (consider, for example, the rise and fall of the theory of learning styles). Alderton & Gifford (2018) state that teachers are "products of discourses which regulate their practice" (p.58) and "drawing on pedagogy normalised by neoliberal concepts of comparison and progress" (p.58), suggesting that the authors believe that teachers, and their beliefs, are formed by the current educational discourse in which they find themselves. Furthermore, two of the studies state:

[The department] were organising themselves around the shared purpose of raising achievement according to school accountability guidelines and appeared to have made a collective decision about change. (Watson & De Geest, 2014, p.354)

It is important to emphasise that teachers in this study were not deliberately acting in ways contrary to effective practice ... but were responding to the

consequences of a common and expected classroom practice. Their practices ... were enacted to provide a best fit in addressing government pressures. (Marks, 2014, p.50)

The authors infer that the influence of socio-cultural context and discourse, in this case government pressures (my emphases), are such that the teachers' observable practice have adapted to accommodate any tension, normalising in this case the practice of using accountability levels as a means of measuring success and failure. It could be suggested that the teachers have 'organised' and 'responded' by integrating the external factors with their macro-beliefs, or conversely by leaving these tensions unresolved, within the adapted practice. Furthermore, to what extent the researchers believe that teachers are aware of this tension is unknown, although one author does state that:

There is far less awareness [amongst teachers] of both the assumptions underlying, and the unexpected consequences of, the practice put into place to respond to these pressures. (Marks, 2014, p.50)

It is interesting to note that Watson & De Geest (2014) do not necessarily view the influence of context as detrimental, stating that:

Some teachers in the school said they had abandoned their own teaching approaches in order to have coherence throughout the school ... from content coverage to developing ways of thinking ...to focus on learning and hybrid methods (Watson & De Geest, 2014, p.364)

It could be inferred that the authors acknowledge that socio-cultural influences on a teacher's beliefs and practice are present, but that the resultant impact could be either beneficial or detrimental.

The clustered data evidence suggests that in this sample of literature the beliefs-to-practice assumption is more consistently reported than the practice-to-beliefs assumption. Furthermore, there is evidence that this is considered by the authors to

be a simple linear relationship, that is to say the deficient practice is a direct result of the teachers' beliefs about low attaining students. In a rather contradictory manner, there is additional evidence that suggests the authors acknowledge the influence of the socio-cultural context and discourse on the observable practice of teachers, with some suggestion that this could be in tension with the teacher's beliefs. However, it is less evident from the literature how the recognition of contextual influence is reflected in the researcher's interpretation of the complex beliefs and practice relationship.

4.5 Researcher interpretation

It is not the intended aim of this project to review or comment on the methodology of each of the individual primary studies and the extent to which they incorporated teacher voice, although it could be argued that process of interpretation regarding the relationship between a teacher's macro-beliefs and observable practice is complex and subject to the subjectivity of the researcher. An acknowledgement of this subjectivity is implied in two of the studies, with isolated comments that state "these notes are based on my perception of how the students felt" (Marks, 2014, p.46) and "It is acknowledged ... that different interpretations could be made of these excerpts" (Tait-McCutcheon & Loveridge, 2016, p.337). That being said it is inescapable, due to the nature of academic research, that at some point the authors will engage with the interpretation process. This can be seen in examples such as:

In referring to [the student] as not conforming to expected behaviour...[the teacher] implied that [the student] had with-in child deficits, attributing [the student's] difficulties to personal characteristics. (Alderton & Gifford, 2018, p.59)

We conjecture that [the department] managed weakness overtly because the head of department was open about areas of mathematics and pedagogy where she was insecure. (Watson & De Geest, 2014, p.363)

In these cases, the observable actions and overt statements of the teachers are being used as evidence of an underlying belief system. However, Faber, Glas, & Visscher (2018) state that:

It is difficult for [the researcher] to judge whether this observed differentiation in instructional activities matches the instructional needs of the students. (p.57)

This gives an indication of the many issues, including practical, around attempting to make interpretations without the teacher's (and in this case also the student's) voice. The complexity of the interpretation process is made more acute by the potential for socio-cultural context and discourse to create a perceived dichotomy between a teacher's observable practice and their professed macro-beliefs. The teacher may adapt their classroom practice to align with contextual pressures and current educational discourse, and yet profess macro-beliefs in tension with this practice; that is to say a dichotomy between what they feel 'compelled' to do compared to what they personally believe is 'good' practice. It could be argued that it would not be possible in this situation to 'observe' the macro-beliefs of a teacher by their overt practice in the classroom.

Speer (2005) states that to understand any possible connection between professed beliefs and observable practice it is necessary to move away from researcher-led interpretation towards a triad of teacher-led interpretation (Figure 3). By giving precedence to the voice of the teacher within the process, the complexities of beliefs and practice can be seen as a shared interpretation through the lens of both the researcher and the teacher involved. It could be argued that the voice of the teacher

needs to be (re)heard in order to create a shared understanding of the complex synergistic belief-practice relationship, especially in the teaching and learning of the lowest attaining students.

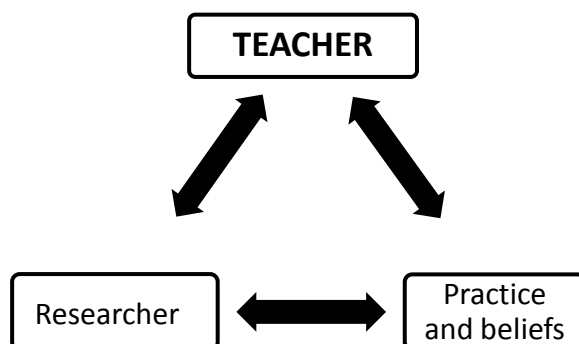


Figure 3: Triad of teacher-led interpretation

In the next chapter, I use the same beliefs-practice-subjectivity framework to review a section of literature that practitioners have recommended as useful in their teaching and learning of low prior attaining students in mathematics.

Notes from the diary

Am I still trying to find evidence to match my conclusions? Should I recheck that extracted data to ensure fairness to the researcher and author?

I am beginning to view this process through the eyes of a researcher as well as a teacher, I seem to be becoming less conflicted by this dual role, maybe I do not need to choose a side after all.

CHAPTER 5 – RESULTS FROM PRACTITIONER RECOMMENDATIONS

5.1 Introduction

In this section of the study, the results are drawn from a review of literature indicated by practitioners in the online survey as useful in their classroom practice with low attaining students. The data extracted as text is clustered together, along with information about the nature and authorship of the sources, to give a picture of the type of literature reported by teachers to be most beneficial to their practice. Furthermore, consideration is given to how the underlying assumptions within the domains of beliefs and practice are represented as well as the authors awareness of their own subjectivity.

5.2 Introducing the recommended literature

The online survey, as described in chapter 3, resulted in four practitioner recommendations that were presented as useful in the teaching and learning of low prior attaining students (see Appendix B). The recommendations include two funded research projects, the focus of which is low attainment in mathematics, and two published books on teaching and learning strategies. Neither book is specific to the teaching and learning of low attaining students within the mathematics classroom. The first project describes the practice of a group of mathematics teachers within the UK education system and focuses on the features that the participants viewed as important in the teaching and learning of low attaining secondary students in mathematics. The analysis includes the review of a booklet located on the project website, published in 2003, that further discusses these key features. The second project is a collaboration that focuses on providing evidence to narrow the achievement gap and improve the teaching and learning in mathematics of low

attaining students. The analysis includes an examination of a systematic review document located on the project website, published in 2018, that considers the international evidence regarding the teaching and learning in mathematics of students aged 9 to 14 years of all attainment levels. The published books are authored by practitioners currently working within the education system, the first is based in the USA and discusses effective teaching and learning strategies observed in the general classroom, and the second considers the evidence found in literature for teaching and learning strategies within the UK mathematics classroom.

5.3 The language of beliefs

In the recommended literature, the use of the alternative versions for the term 'beliefs' was more problematic to establish due to the nature of the sources. A simple word search was possible for the published literature from the project websites, with an appraisal of the use of these aliases with regard to teachers' beliefs and excluding any reference to students' beliefs (see Table 6 for frequency count).

Key term	Frequency	Key term	Frequency
Beliefs	17	Theory	1
Position	0	Assume	2
Perceive	0	Understanding	1
Regard	0	Storyline	0
Aware	4	Expectation	19
Grounded	0	View	6

Table 6: Frequency of key belief terms in project literature

The two published books were in hard copy format and therefore a word search was neither practical nor constructive. However, notwithstanding the issues with the hard copies, it seems evident that for the authors of the project literature the use of an alias for the term 'beliefs' was less frequently chosen than for the sampled academic literature in Chapter 4.

5.4 Underlying themes

It is argued that teachers engage with literature that is of most relevance to their context and which they consider useful to inform their practice (Cain, Teachers' engagement with published research: addressing the knowledge problem, 2015; Levin, 2013). The underlying theme that connects all the recommended literature is the practical nature of its content; the authors consider, develop and critique examples of classroom experience that would resonate with many teachers, affording the opportunity to consider the evidence and principles that underpin the highlighted practice (Cordingley, 2015). Below, I consider how these authors represent the relationship between this practice and the underlying beliefs of a teacher, and the discussion around the impact of context on teachers' practice.

5.4.1. Beliefs and practice

The duality of assumptions about the relationship between beliefs and practice has been discussed previously as beliefs leading to practice and practice as evidence of beliefs. Within the recommended literature it is evident that the role of beliefs is considered to have an important impact on the students' experience:

The main drive for the teachers was a shared belief that all students can learn mathematics so that efforts made to help them do so were going to be worthwhile. (Watson, De Geest, & Prestage, 2003, p.9-10)

High expectations amongst teachers are the most reliable driver of high achievement [for students]. (Lemov, 2015, p.89)

Teachers' beliefs about their ability to teach appear to be critical for lower-attaining students in Key Stage 3 mathematics. (Hodgen, Foster, Marks, & Brown, 2018, p.164)

It could be argued that the authors view beliefs as a key starting point that goes on to influence the teachers' choice of practice, with Watson, De Geest, & Prestage (2003) clearly stating:

If you share this belief [that all students can learn mathematics], this booklet will show you how a group of varied teachers try to put the belief into practice, in many different ways, with a range of results. If you do not share this belief, this booklet will have little to offer you. (p.2)

Furthermore, the actions of the teachers in the classroom which may expose their beliefs to the students may be significant:

Some teachers' actions, such as a challenge to "think deeply"... and the promotion of an incremental, or malleable, theory of intelligence, appear to encourage the learners... (Hodgen, Foster, Marks, & Brown, 2018, p.15)

However, it is not stated in this example how this 'theory of intelligence' is promoted in the learning environment and why the teachers' actions were impactful. However, Lemov (2015) discusses classroom practice as beliefs-in-action:

So, what are the concrete, actionable ways that teachers demonstrate high expectations? (p.8-9)

In this case, the author goes on to provide practical strategies which, in their opinion, an effective teacher uses in the classroom that demonstrates to students that the teacher has high expectations. It could be argued that the students can be made aware of the beliefs of the teacher by their observable classroom practice, and consequently this awareness impacts on the beliefs of the students themselves.

For one author the impact of their own beliefs on their practice is clearly stated:

[in the section on 'What I used to do'] I explain my previous beliefs, where they came from, and how they impacted on what I did in the classroom. (Barton, 2018, p.20)

The author goes on to discuss how they have changed their classroom approach based on inspiration from research papers, books and input from knowledgeable others, and hence provides practical strategies for teachers to access. It could be argued that changes in beliefs are considered as implicit in this change in practice, the overt behaviour giving an indication of a teacher attempting to resolve the tensions introduced into their beliefs-practice context by the literature.

The evidence suggests that for the authors of the recommended literature the synergy between teacher beliefs and practice is a key factor that influences the teaching and learning experiences of students in the mathematics classroom. Furthermore, the authors suggest that the teachers' practice in the classroom is interpreted by the students as beliefs-in-action, that is to say observable evidence of the teachers' beliefs. There seems to be consensus that this beliefs-in-action is particularly important for the lowest attaining students. However, this recommended literature goes further in the "knowledge mobilisation process" (Levin, 2013, p.2) in that it discusses the practical strategies that emerge, and how the beliefs-in-action practice can be used in the classroom.

5.4.2 Practice and contextual pressure

Levin (2013) states that the influence of social context and discourse is a key factor in shaping both institutional policy, and classroom practice "mediated through personal experiences. collegial knowledge and organisational culture" (p.12). There

are examples in the recommended literature that suggests the authors consider the influence of context to have negative consequences:

Most of the time [the teachers] are tasked with executing ideas and directives that come from elsewhere, from people who don't actually teach every day. As a result, many of those ideas and directives are disconnected from the challenges that shape a teachers' daily work. (Lemov, 2015, p.6)

The belief in 'catch up' [tasks for low attaining students] is partly generated by genuine concern about students' ability to handle more advanced concepts, partly by political targets, partly by the provision to all schools of materials with which to do this task, and partly by the misinterpretations of these materials and their purpose by school managers and governors. (Watson, De Geest, & Prestage, 2003, p.3)

However, conversely, it is evident that the authors believe that the influence of context on classroom practice can also be positive:

Teachers knowledge, more particularly pedagogic content knowledge, is crucial in realising the potential of mathematics curriculum resources and interventions to raise attainment. Professional development is key to raising the quality of teaching and teacher knowledge. (Hodgen, Foster, Marks, & Brown, 2018, 16)

The authors go on to discuss the need for effective professional development, in order to support teachers, on seven separate occasion in the review of effective teaching and learning strategies in mathematics. Furthermore, they infer that professional development is most effective when it is embedded in the socio-culture context and consistent with the requirements of the teacher. It is evident that the organisational culture in which a teacher works is considered key to successful practice, as these examples show:

In our field, the first obligation is to help teachers succeed. When teachers end the day with a sense of accomplishment, when they feel they are both successful and growing more so, they stay in our schools for a long time, do outstanding work, work joyfully, and inspire others, and thus pay the organisation back in spades. (Lemov, 2015, p.4)

This project shows that teachers who are free to innovate for themselves are able to improve the attainment, engagement and mathematical thinking of low attaining students (Watson, De Geest, & Prestage, 2003, p.51)

It could be argued that what is implicit in these examples is that this culture may not always be present within educational organisations.

One author infers that the social context and discourse is not only at an organisational level, stating “the day I started reading educational research was the day my life changed” (Barton, 2018, p.18). It seems that the ‘context’ of engaging with research literature changed both their beliefs and classroom practice. Cain (2015) states that the influence of research literature on a teacher’s practice occurs through “enlightenment” (p.493), as teachers interpret the findings through the lens of their own beliefs and classroom experiences. Barton (2018) goes on to interpret the research findings from his personal insight process into practical teaching and learning strategies that are easily accessible, opening up the process of enlightenment to other teachers.

There seems to be consensus amongst the authors of the recommended literature that the socio-cultural context and discourse that surround a teacher is impactful on their classroom practice. It is evident that this influence is seen as having the potential for either a negative or a positive impact on classroom practice and as a consequence, the teaching and learning experiences of students; in fact, it could be argued that the literature itself is presented as a tool for positive influence by engaging in the development and critique of what is suggested as effective classroom strategies. Levin (2013) states that teachers often have trouble in disentangling the role of contextual influences on practice and hence, it is not explicitly discussed in the recommended literature the extent to which teachers are aware of any tension that

may exist between their professed beliefs and observable practice. That being said it could be argued that a beliefs-practice tension may have lead the teacher to search out the literature in the first place and is therefore implicit in the inception of the enlightenment process.

5.5 Authors' interpretation

The issues around the interpretation of a teacher's observable action has been previously highlighted as subjective and practically complex. This is acknowledged by two of the authors:

Surely, when one of the teachers I was watching did the thing that drove her results, I was looking in the other direction, misunderstanding what she'd done, confusing cause for effect, or seeing what I wanted to see for at least some of the time. (Lemov, 2015, p.7)

Despite what many of my students may tell you, I am a human being, and as a human being I am susceptible to a number of cognitive biases that are directly relevant to what you are about to read. (Barton, 2018, p.22)

However, the voice of the teacher in the interpretation process is key to a shared understanding (Speer, 2005). Within the recommended literature, it seems evident that the input of the teacher is considered central in the process of knowledge and practice development:

The research team did not tell teachers what to do, nor provide instructions about good tasks or good ways to organise teaching. Instead, teachers and researchers all put ideas into the discussions. What the teachers did in their classrooms was, therefore, their own ideas or adoptions and adoptions of ideas from others. (Watson, De Geest, & Prestage, 2003, p.52)

As a result [of a data-driven approach to guidance], it considers teachers not just as recipients and implementers of the field's knowledge but as creators of it. (Lemov, 2015, p.8)

The recommended literature does not consider how to change a teacher's beliefs but rather concentrates on how to change their practice, and it could be argued that a

change, or reawakening, of beliefs is implicit in this process. In a sense this could be seen as a cyclic experience where beliefs play a role in introducing new practice, and reflection further leads to or reinforces beliefs, which in turn embeds and extends new practice. The consensus of the authors is that giving agency to a teacher over their choice of practice is paramount:

The more I read and the more I experimented, the more questions I had. So, I read more, spoke to more people, tried more stuff with my students and colleagues... (Barton, 2018,p.19)

I believe that given the tools here, teachers can make insightful, independent decisions about how and when to use the techniques of the craft as they go about becoming masters of the art of teaching. (Lemov, 2015, p.12)

...teachers who are free to innovate for themselves are able to improve the attainment, engagement and mathematical thinking of low attaining students. (Watson, De Geest, & Prestage, 2003, p.51)

Cain (2015) describes this teacher-led process as the transformation of research generated knowledge into pedagogical practice by “testing it against their own experiences” (p.499). Within the recommended literature there is a sense of working with and alongside the teacher, as well as a recognition of their contextual influences. The voice of the teacher is embedded in the knowledge generation process and, from my viewpoint as a teacher-researcher, giving a legitimacy to the authors’ interpretation of macro-beliefs and the transformation of observable practice.

In the next chapter, I compare the results of my finding in Chapter 3 and Chapter 4 and discuss the implications of giving priority to teacher voice in academic literature.

Notes from the diary

The teacher has been moved to a central position in this literature and practice is prioritised. Is this why teachers choose this literature? It seems to take the academic and apply it to the practical, it makes it personal.

I do wonder to what extent I may be viewing the literature recommended by practitioner differently because of my background as a mathematics teacher. Does it resonate because of the practicality of its outcomes?

Surely this is the purpose of educational research.

How can I become this type of teacher-researcher?

CHAPTER 6 - CONCLUSIONS

6.1 Discussion

This study has examined the narrative around teachers' beliefs and observable practice in literature that discusses the teaching and learning of low attaining students in mathematics and seeks to address the following questions. Firstly, how is the complex relationship between a teacher's beliefs and observable practice represented in literature and to what extent is the subjectivity of interpretation acknowledged? And secondly, the study considers the implications of researcher-led and teacher-led interpretations and asks what could be the impact of giving priority to teacher voice in academic and other professional literature?

There is a consensus in both the sampled academic literature and the literature from practitioner's recommendations that the macro-beliefs of a teacher can have an impact on observable of practice in the classroom. The type of macro-belief most prevalently mentioned as related to the teaching and learning of low attaining student is the belief relating to the mathematical potential of students, however there is less agreement on the impact of these beliefs on practice. With the notable exception of Watson & De Geest (2014), the sampled academic literature seems to take a deficient view focusing on the non-effective practice with regard to the teaching and learning of low attaining students, that is inferred in both Alderton & Gifford (2018) and Faber et al (2018) to be the result of the low expectations, and in Marks (2014) to be the result of shared assumption of inherent ability. In Tait-McCutcheon & Loveridge (2016) it is the teacher's beliefs about the nature of mathematics that is discussed as the precursor of observable practice. However, there are fewer references in this literature to the inference of beliefs though the

lens of observed practice. It is solely in Tait-McCutcheon & Loveridge (2016) that this assumption is presented conclusively with six references to 'observing' beliefs through the lens of overt practice. In contrast to the deficient stance, the literature recommended by practitioners seems to take a sufficient view by focusing on the choices of effective practice that a teacher could apply to enhance the teaching and learning experiences of low attaining students, in addition both Lemov (2015) and Hodgen et al (2018) make some reference to the authors' interpretation that students recognise the observable practice as beliefs-in-action. The role of beliefs in the choice of practice is highlighted by Watson et al (2003), Lemov (2015) and Hodgen et al (2018) as a key factor, however the focus on introducing effective practice over the explicitly influencing beliefs could suggest that a teacher's beliefs should not be seen as a limiting factor; that is to say, the teacher, given enough support and confidence, can challenge and re-evaluate their beliefs by experimenting with new practice in their real world of teaching and learning of low attaining students.

It is acknowledged in both the sampled literature and the literature recommended by practitioners that observable practice is often influenced by the socio-cultural context and discourse that surround the teacher. In a similar manner to the above discussion about the beliefs-practice relationship, there seems to be a deficient vs sufficient view of the teacher's response to contextual influence. The sampled literature suggests that teachers adapt their practice to accommodate contextual influences and pressures. with both Marks (2014) and Alderton & Gifford (2018) suggesting that to some extent the teacher will conform even if it introduces tension with their micro-beliefs. This is in contrast with the literature recommended by practitioners, in which contextual influence when discussed is framed as having the

potential to have a negative or positive impact. In Lemov (2015) and Watson et al (2003) the teacher is presented as having the ability to consider and challenge any contextual influence through the lens of their macro-beliefs and past classroom experiences. Furthermore, it is explicitly stated in the recommended literature (Levin, 2013; Watson et al, 2003) that giving teachers the agency to make these evaluations is paramount to success in the experiences and outcomes of low prior attaining students.

The subjectivity that may influence the interpretations presented by the authors in any literature is an important issue to address. The issues around shared meaning of vocabulary, as well as the influence on the teacher as a participant in research, can impact on the researcher-teacher interpretation process and cause problems in the inference of beliefs (Speer, 2005; Leat, Reid, & Lofthouse, 2015). It could be argued that a process that is said to interpret the observable actions and macro-beliefs of a teacher must be led by the teacher themselves, in a triad of interpretation that involves the teacher, the researcher and the action or object of interest. However, it must be acknowledged that meaning making is a complex process (Wertsch, 1991) and that self-reporting, whether of beliefs or behaviour, is considered unreliable (Levin, 2013). The most that could be argued is that introducing a teacher-led triad of interpretation will bring the researcher and teacher to a closer, but not a complete, shared understanding.

An interesting distinction between the sampled literature and literature recommended by practitioners is the extent to which the literature could be viewed as contributing not only to research generated knowledge of education but also

pedagogical knowledge for the teacher, two ‘types’ of knowledge often considered to be dichotomous in nature (Cain, 2015). Whilst acknowledging the issues of generalisation with such a small sample, it is true to say that in this case and in contrast to the mostly deficient stance of the sampled academic literature, the literature chosen by practitioners is explicit in its presentation of the merits and underlying theories of strategies and overt practice, that could be readily be applied by a teacher for change in the mathematics classroom. This could be described as creating knowledge for education as opposed to solely knowledge of education. A notable exception is found in the sampled work of Watson & De Geest (2014) who interestingly also feature as authors in the recommended literature. Biesta et al (2015) suggest there is an interaction between beliefs and agency, that is to say having the capacity to shape and influence their context, that enables teachers to be “explicitly positioned as agents for change” (p.625). By putting the voice of the teacher as central to the research the influence and outcomes can move from ‘what is’ to ‘what could be’; that is to say transforming educational research from the interpretations about the observed current practice in the classroom into discussions about strategies for future positive change. Consequently, the recommended literature goes further than most of the academic literature in that there is a sense of the strategies being tested proactively by teachers in and against their own day-to-day classroom experiences (Cordingley, 2015; Cain, 2015). The use of teacher voice provides the literature itself as having the potential for positive influence in the socio-cultural context and discourse of a teacher, giving them the tools to actively discuss, develop and critique practice in the classroom and challenge their own macro-beliefs.

6.2 Limitations and further study

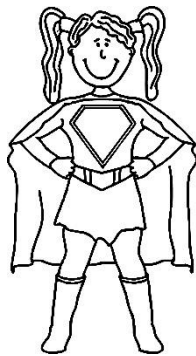
The limitations of this study are found in the sample size of the literature reviewed. The outcomes are a discussion of the findings from a review of the small amount of sampled literature and should be viewed as a conversation starter rather than a generalisation of all academic and professional literature. It is important also to acknowledge my own subjectivity, these findings are my own interpretation of the data, taken from my viewpoint as an experienced teacher and a very early researcher and ironically without the input of the researchers and authors of the literature. The interesting questions that are beyond the scope of this study are how can schools, and other institutions, ensure that a culture is created where teachers are given voice and the freedom to innovate and as a consequence change the educational experiences of low attaining students? What are the socio-cultural influences that surround a headteacher that may make them wary of introducing this culture? And importantly, how can we as researchers ensure that our outcomes contribute to knowledge for, rather than just knowledge of, education? If the purpose of research is to enhance the practice of teachers, then we need to consider the nature of this audience. I suggest that the findings of research should both add to the current academic understanding and be useful and accessible to the teaching profession. Cordingley (2015) suggests that practitioner specific summaries might be a first step "thus positioning research as a practical source of expertise" (p.248), however in my view a more systemic change is required. I propose that rather than finding a way to make the current research process accessible to teachers, as researchers we should be considering how to adapt our practice in order for our research to work with and for the teacher audience.

Notes from the diary

Who am I?

I am a teacher-researcher who will always be faithful to my roots as a teacher, a hybrid if you wish, who is no longer conflicted by the sense of having to choose a side.

I have decided that there are no sides, there is no division between past loyalties and current circumstances. The purpose of my educational research will be support the art of the teacher, a researcher contributing knowledge 'for' the teacher rather than just 'of' the teacher. This is me, I still have questions, just different ones....



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APPENDIX A – SAMPLED LITERATURE

Code	Source details
001	Teaching Mathematics to Lower Attainers : Dilemmas and Discourses Julie Alderton and Sue Gifford (2018)
002	Educational Triage and Ability-Grouping in Primary Mathematics : A Case-Study of the Impacts on Low-Attaining Pupils Rachel Marks (2014)
003	Differentiated instruction in a data-based decision-making context Janke M. Faber, Cees A. W. Glas & Adrie J. Visscher (2018)
004	Examining equity of opportunities for learning mathematics through positioning theory Sandi L. Tait-McCutcheon ¹ & Judith Loveridge ¹ (2016)
005	Department-initiated change Anne Watson & Els De Geest Published online: 20 May 2014 # Springer Science+Business Media Dordrecht 2014

Primary literature appraisal proforma

Code	001						
Source details	Teaching Mathematics to Lower Attainers : Dilemmas and Discourses Julie Alderton and Sue Gifford (2018)						
Study purpose and type (Summary from abstract)	This article draws on Foucault's concepts of power and discourse to explore the issues of teaching mathematics to low attainers in primary schools in England						
Sample type	Database search			Practitioner recommendation			
	ERIC						
Unique project (avoid multi lit from same study)	Yes	x		No			
Title, abstract or keywords appraisal, with regard to teachers: (Tick if present)	Beliefs	Assumptions	Expectations	Instruction	Pedagogy	Practice	Discourse
				x		x	x
Phase or ages of pupils?	Primary age						
Education system(s)?	UK						
Include in study?	Yes	x	NO		Undecided (explain below)	x	
Notes	Not secondary age students Covers discourse around ability and lower expectations						

Code	002						
Source details	Educational Triage and Ability-Grouping in Primary Mathematics : A Case-Study of the Impacts on Low-Attaining Pupils Rachel Marks (2014)						
Study purpose and type (Summary from abstract)	This case-study, drawing on an unanticipated theme arising from a wider study of ability-grouping in primary mathematics , documents some of the consequences of educational triage in the final year of one primary school						
Sample type	Database search			Practitioner recommendation			
	ERIC						
Unique project (avoid multi lit from same study)	Yes	x		No			
Title, abstract or keywords appraisal, with regard to teachers: (Tick if present)	Beliefs	Assumptions	Expectations	Instruction	Pedagogy	Practice	Discourse
		x				x	
Phase or ages of pupils?	primary						
Education system(s)?	uk						
Include in study?	Yes	x	NO		Undecided (explain below)	x	
Notes	Primary age students (year 6) Discusses 'assumptions' and 'theories' about learners						

Code	003						
Source details	<p>Differentiated instruction in a data-based decision-making context</p> <p>Janke M. Faber, Cees A. W. Glas & Adrie J. Visscher (2018)</p>						
Study purpose and type (Summary from abstract)	In this study, the relationship between differentiated instruction, as an element of data-based decision making, and student achievement was examined.						
Sample type	Database search ERIC			Practitioner recommendation			
Unique project (avoid multi lit from same study)	Yes	X			No		
Title, abstract or keywords appraisal, with regard to teachers: (Tick if present)	Beliefs	Assumptions	Expectations	Instruction	Pedagogy	Practice	Discourse
				X			
Phase or ages of pupils?	Primary age						
Education system(s)?	Holland??						
Include in study?	Yes	X	NO		Undecided (explain below)	x	
Notes	Primary age students						

Code	004						
Source details	Examining equity of opportunities for learning mathematics through positioning theory Sandi L. Tait-McCutcheon ¹ & Judith Loveridge ¹ (2016)						
Study purpose and type (Summary from abstract)	This exploratory study examined how two teachers from two New Zealand primary schools introduced and taught the same mathematics lesson to their lowest ability group of year 2 and 3 students.						
Sample type	Database search ERIC			Practitioner recommendation			
Unique project (avoid multi lit from same study)	Yes	x		No			
Title, abstract or keywords appraisal, with regard to teachers: (Tick if present)	Beliefs	Assumptions	Expectations	Instruction	Pedagogy	Practice	Discourse
					x		
Phase or ages of pupils?	Primary						
Education system(s)?	New Zealand						
Include in study?	Yes	x	NO		Undecided (explain below)	x	
Notes	Primary age New Zealand Discusses equitable opportunities based on teacher position						

Code	<u>005</u>						
Source details	<p>Department-initiated change</p> <p>Anne Watson & Els De Geest Published online: 20 May 2014 # Springer Science+Business Media Dordrecht 2014</p>						
Study purpose and type (Summary from abstract)	This paper reports the activity of three secondary school mathematics departments in England in self-initiated states of change that led to overall improvements in students' achievements when compared to previous cohorts.						
Sample type	Database search BEI				Practitioner recommendation		
Unique project (avoid multi lit from same study)	Yes	x			No		
Title, abstract or keywords appraisal, with regard to teachers: (Tick if present)	Beliefs	Assumptions	Expectations	Instruction	Pedagogy	Practice	Discourse
					x		
Phase or ages of pupils?	Secondary						
Education system(s)?	<u>uk</u>						
Include in study?	Yes	X	NO		Undecided (explain below)	<u>x</u>	
Notes	<p>The beliefs are teachers are not dominant in this project but are discussed with regard to lack of involvement.</p> <p>Interesting due to lack of reference to beliefs and associated language when considering change to observable practice</p>						

APPENDIX B - LITERATURE RECOMMENDED BY PRACTITIONERS

Code	Source details
101	Deep Progress in Mathematics: the improving attainment in mathematics project Anne Watson, Els de Geest, Stephanie Prestage (2003)
102	Low attainment in mathematics: an investigation of Year 9 students (Project) Leading to Improving Mathematics in Key Stage Two and Three: Evidence Review Jeremy Hodgen, Colin Foster, Rachel Marks, Margaret Brown (2018)
103	Teach like a Champion 2.0 (book) Doug Lemov (2015) San Francisco : John Wiley & Sons Inc.
104	How I wish I'd taught maths. (book) Craig Barton (2018) Woodbridge: John Catt Educational Ltd

Code	<u>101</u>							
Source details	<p>Deep Progress in Mathematics: the improving attainment in mathematics project</p> <p>Anne Watson, Els de Geest, Stephanie Prestage (2003)</p>							
Study purpose and type (Summary from abstract)	<p>The resource describes how a group of ten teachers taught low attaining groups in secondary school, and what features were seen as important. The teachers had a shared commitment to improving the attainment of their lowest attaining students by building on the belief that all students can think hard about mathematics, and thus improve.</p>							
Sample type	Database search				Practitioner recommendation			
					Survey Monkey			
Unique project (avoid multi lit from same study)	Yes	x			No			
Title, abstract or keywords appraisal, with regard to teachers: (Tick if present)	Beliefs	Assumptions	Expectations	Instruction	Pedagogy	Practice	Discourse	
	x	x	x			x		
Phase or ages of pupils?	Secondary							
Education system(s)?	UK							
Include in study?	Yes	X	NO			Undecided (explain below)		
Notes	<p>All practitioner recommendations included.</p> <p>Mathematics and low attainment specific</p> <p>2003 (fifteen years ago)</p> <p>Supported by the Esmee Fairbairn Foundation and the Universities of Oxford and Birmingham</p>							

Code	<u>102</u>						
Source details	Low attainment in mathematics: an investigation of Year 9 students (Project) Leading to Improving Mathematics in Key Stage Two and Three: Evidence Review Jeremy Hodgen, Colin Foster, Rachel Marks, Margaret Brown (2018)						
Study purpose and type (Summary from abstract)	This project aims to provide evidence to inform policy and practice directed at narrowing the achievement gap in mathematics, improving the teaching of secondary low attainers, and informing the design of appropriate interventions.						
Sample type	Database search			Practitioner recommendation			
				Survey Monkey Personal email			
Unique project (avoid multi lit from same study)	Yes	x			No		
Title, abstract or keywords appraisal, with regard to teachers: (Tick if present)	Beliefs	Assumptions	Expectations	Instruction	Pedagogy	Practice	Discourse
	x		x		x	x	
Phase or ages of pupils?	Primary and Secondary (ages 9 to 14)						
Education system(s)?	UK						
Include in study?	Yes	X	NO		Undecided (explain below)		
Notes	All practitioner recommendations included. Mathematics and low attainment specific 2018 Supported by the Nuffield Foundation and copyright EEF						

Code	<u>103</u>						
Source details	Teach like a Champion 2.0 (book) Doug Lemov (2015) San Francisco : John Wiley & Sons Inc. Original recommendation stated 'Teach like a Champion '						
Study purpose and type (Summary from abstract)	Sharing 'tangible best practice that the most effective teachers have in common' (p.xxxii) My goal was to find as many such teachers as I could and honor (sic) them by focusing on, and studying , their teaching. (p.3)						
Sample type	Database search			Practitioner recommendation			
				Survey Monkey			
Unique project (avoid multi lit from same study)	Yes	x		No			
Title, abstract or keywords appraisal, with regard to teachers: (Tick if present)	Beliefs	Assumptio ns	Expectatio ns	Instruction	Pedagogy	Practice	Discourse
			x		x	x	
Phase or ages of pupils?	Non-specific						
Education system(s)?	USA						
Include in study?	Yes	x	NO		Undecided (explain below)		
Notes	All practitioner recommendations included. Not Mathematics and low attainment specific Based on USA education system 2015 Focuses on sharing teachers best practice						

Code	<u>104</u>							
Source details	How I wish I'd taught maths. (book) Craig Barton (2018) Woodbridge: John Catt Educational Ltd							
Study purpose and type (Summary from abstract)	Research based evidence unpacked in a practical, teacher friendly manner The book cover 12 key themes, with each theme further broken down into ideas.							
Sample type	Database search				Practitioner recommendation			
					Survey Monkey			
Unique project (avoid multi lit from same study)	Yes	x			No			
Title, abstract or keywords appraisal, with regard to teachers: (Tick if present)	Beliefs	Assumptions	Expectations	Instruction	Pedagogy	Practice	Discourse	
			x		x	x		
Phase or ages of pupils?	Non-specific							
Education system(s)?	UK							
Include in study?	Yes	X	NO		Undecided (explain below)			
Notes	<p>All practitioner recommendations included.</p> <p>Mathematics and but not low attainment specific (there is a small section on teaching low-achieving students)</p> <p>2018</p> <p>Focuses on authors own journey of reviewing research and hence developing teachers' best practice.</p>							

APPENDIX C – DATA COLLECTION FORM

Code	
Source details	
Key Terms (with reference to teachers)	
Beliefs lead to practice	
Beliefs evident from practice	
Practice in tension with beliefs	
Practice influenced by social context or discourse	
Professed beliefs interpreted by researcher	
References used	

APPENDIX D – SURVEY INFORMATION

Information sheet for online recommenders.

Twitter (280 characters or less) 351 characters with spaces! (2 PART MESSAGE)

I am carrying out a study on academic literature that discusses teacher's pedagogy with low prior attaining students in mathematics. If you are currently involved in mathematics education, I would be grateful if you could let me know of any academic literature that you have found useful in your practice using 'survey link' below. *Google survey link*

Full information on survey

The purpose of this study is to analyse the academic literature that discusses teacher's pedagogical practice with low prior attaining students in mathematics. If you are currently involved in mathematics education, I would be grateful if you could let me of any academic literature you have read that has been useful to your practice. I do not need any personal details about you, just the author, date and full title of the literature so that I can subsequently find the literature myself.

Completing this survey is voluntary, please close the survey if you do not want to continue. All information and recommendations given will be stored securely on a password protected computer and destroyed on or shortly after the 10th September 2018.

If you have any further questions, please contact me on my email address: rh17980@my.bristol.ac.uk.

APPENDIX E – ETHICS

Name(s): Rachel Helme

Proposed research project: A meta theory analysis of teacher's beliefs and practice in the low prior attaining mathematics classroom

Proposed funder(s): none

Discussant for the ethics meeting: Wei Zheng

Name of supervisor: Julian Brown

Has your supervisor seen this submitted draft of your ethics application? Y

Please include an outline of the project or append a short (1 page) summary:

A library-based project that will use the tenets of meta theory to see how teacher's beliefs and overt practices are represented in literature on low prior attaining mathematics classrooms. I will consider how the theory has been developed in the primary literature, and the underlying structure, and the nature of the academic references used. I will investigate how the primary literature considers the possible relationship between teacher's own beliefs and their overt pedagogical practice.

Post discussion: Using database searches and teacher practitioner's recommendations, I will examine the primary literature for themes and how references are used, to get a picture of how the theoretical frameworks are developed in the primary literature. This will not be considered generalisable but 'conversation opener' on how literature discusses current practice in the classroom.

Ethical issues discussed, and decisions taken (see list of prompts overleaf):

The 'participants' in this project are the primary literature that will be sampled from a database search as well as literature that has been read or recommended by teacher practitioners on the teacher forums on twitter. Full information will be provided on twitter describing the project and that the teacher practitioners do not have to recommend literature if they do not want to. (Information sheet attached). An online survey tool will be used to allow for anonymity in this recommendation process and to mitigate any possible research bias from the perceived status of the recommender.

Post discussion: I will ask teacher practitioners to recommend literature that they have found useful in their own practice and ensure that I share the start and finish

date for this sampling. I will ensure that teachers are aware not to direct message or reply on twitter to this request to protect confidentiality and anonymity. I will add a question for informed consent to use their recommendations on the online survey form,

The process of appraisal of the primary literature will be completed fairly using the proforma attached, using term that could relate to beliefs e.g. perception, expectation, and terms that could relate to practice, e.g. instruction, pedagogy. The final terms will be fixed after a pilot search and appraisal has taken place but at no time will any terms that relate to perceived quality of the primary literature be used. The purpose of the project is to investigate and discuss how teacher's beliefs and overt practices are represented., highlighting but not criticizing academic practice.

The data extracted from the literature will be stored securely on the researcher's password protected laptop, and synthesis and results presented clearly and fairly without comment on perceived quality.

Post discussion: Data will be protected in line with www.bristol.ac.uk/secretary/data-protection.

The most important ethical issue, as previously stated, is the responsibility to be open and fair to the academics who authored the primary research. The purpose of the project is to investigate how the theory is presented and developed and will not comment on any perceived quality. The findings will be discussed in light of the researchers own literature review on teacher's beliefs and overt practice in order to provide a theoretical framework for discussion.

Post discussion: The appraisal proforma will ensure that the primary literature sample is appraised in a consistent manner.

If you feel you need to discuss any issue further, or to highlight difficulties, please contact the GSoE's ethics co-ordinators who will suggest possible ways forward.

Signed: Rachel Helme (Researcher)

Signed: Wei Zheng (Discussant)



Rachel Helme <rh17980@my.bristol.ac.uk>

Ethics Online Tool: application signed off

Research Governance and Ethics Officer <Liam.McKervey@bristol.ac.uk>

Wed, Jul 25, 2018 at
9:53 AM

To: rh17980@my.bristol.ac.uk

Your online ethics application for your research project "A meta theory analysis of teacher's beliefs and practice in the low prior attaining mathematics classroom" has been granted ethical approval. Please ensure that any additional required approvals are in place before you undertake data collection, for example NHS R&D Trust approval, Research Governance Registration or Site Approval.

For your reference, details of your online ethics application can be found online here:

<http://www.bristol.ac.uk/red/ethics-online-tool/applications/72442>